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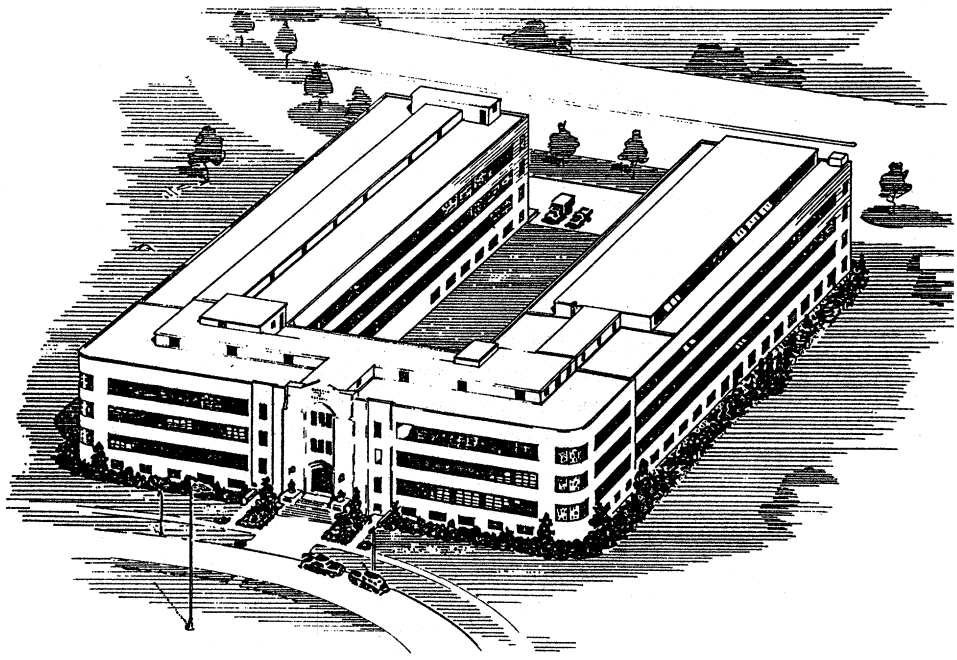

PERMANENT GLASS COLOR STANDARDS FOR EXTRACTED HONEY[1]

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Color has long been an important factor in the marketing of extracted honey. In recognition of the importance of this factor, the Department established a color classification for extracted honey in 1927[4] and made it a part of the United States Standards for Grades of Extracted Honey. These colors are designated as Water White, Extra White, White, Extra Light Amber, Light Amber, and Amber. The official instrument for determining color classification according to these standards has been the Pfund wedge comparator, which has been described in previous publications[4,5] and is commercially available. This instrument contains a wedge of amber glass, a wedge-shaped cell for holding a honey sample, and a millimeter scale with pointer to indicate wedge positions where a color match is obtained. The boundaries of the color ranges corresponding to the above color standards are specified[6] in terms of scale readings on this instrument.

The Pfund wedge comparator is satisfactory as a laboratory instrument but is impractical for field use. There is a great need in the industry for a simpler and less expensive grading device. Attempts in this direction have been made in the past by use of cylindrical bottles or tubes as sample containers and colored solutions or colored glass as material standards but without success in this country. The recent successful development of a simple color comparator with permanent glass standards for maple sirup[7] suggested application of a similar system to extracted honey. Tests made during the past year confirmed its suitability.

The purpose of the present publication is to briefly describe the new comparators and permanent glass standards for color classification of extracted honey and to announce their commercial availability. It should be pointed out that although the United States Standards for Grades of Extracted Honey

have recently been revised[8] the color requirements have not been cnanged but are now represented by permanent glass color standards for use in classifying the color of extracted honey. The permanent glass color standards are made a part of the revised United States Standards for Grades of Extracted Honey which became effective April 16, 1951. The Pfund wedge comparator may be used henceforth only for approximate color classification.[8]

Before glass color standards could be developed it was obviously necessary to decide on a suitable standard thickness or layer depth of honey, and a suitable sample container for use in grading for color. Tests made with clarified honeys, selected and blended to correspond to the standard scale readings of the Pfund wedge comparator, indicated that 2-ounce square bottles having an internal thickness of 1.24 inch (31.5 mm.) met the requirement for satisfactory containers. The advantages of these bottles are: (1) they are inexpensive and available commercially; (2) the relatively large thickness of layer facilitates precise grading, since honeys of standard color are widely spaced on a color scale when viewed in this thickness; and (3) the square shape provides a field of view of uniform thickness and uniform color, a feature which would not be possible with cylindrical containers. These bottles should also be suitable and convenient for use as sample bottles in connection with the marketing of honey.

Selection of suitable colored glasses to be used as standards was done by means of spectrophotometric measurements on filtered honeys, solutions of caramel in glycerin, and commercially available colored glasses. Phillips[9] has shown that the spectral transmittance of honey is subject to variation depending on its source and turbidity. Our preliminary tests, however, showed that solutions of caramel in glycerin were good spectral matches and good color matches with typical filtered honeys, and that such solutions were more convenient than honeys as temporary secondary standards to aid in the development of glass standards. Caramel-glycerin solutions were, therefore, prepared which gave standard scale readings on the Pfund wedge comparator, and their spectral properties measured in 31.5 mm. thickness. Pfund scale readings and absorbance at only one wave-length are shown in Table I for these solutions. Commercial colored glasses were then found which, when ground and polished to our thickness specifications, duplicated closely both the visual colors and the spectral properties of the caramel-glycerin solutions (and hence typical honeys) in 31.5 mm. thickness. A more complete description of the glass color standards with detailed colorimetric specifications will be published elsewhere. The Department has arranged for the purchase of a large supply of the selected colored glasses

so that an adequate supply for the estimated needs of the industry is assured. All individual glasses are tested at the Eastern Regional Research Laboratory to assure close standardization of duplicate glasses.

The new color comparators (Figs. 1 and 2) containing the permanent glass color standards are all-metal boxes having dimensions approximately 8 by 2 by 3 inches, divided by thin partitions into five square compartments, each of which has two windows approximately 1.2 inch square. The three lighter glass standards (Water White, Extra White, and White) are mounted in one of the comparator boxes on a shelf against the front windows in compartments 1, 3 and 5. The three darker standards (Extra Light Amber, Light Amber, and Amber) are mounted in a similar manner in a second comparator box. Three square sample bottles filled with distilled water (referred to as "blanks") are placed in the compartments behind the glass standards in the comparator being used for grading. Empty square bottles are provided for honey samples. A bottle containing honey to be classified is placed in the appropriate comparator in either compartment 2 or 4 so that it will be between adjacent standards. To assist in the classification of honeys which are appreciably turbid, three square bottles containing suspensions of bentonite in distilled water are provided. These are referred to as "Cloudy 1", "Cloudy 2", and "Cloudy 3", and are used interchangeably with any one of the clear blanks to reduce the brightness of a glass standard to a level near that of the honey to be classified.

The following procedure is used in classifying extracted honey with these comparators.

(1) The clear blanks or the cloudy suspensions are placed in back of the glass standards in compartments 1, 3 and 5 of one or both of the comparators.

(2) The honey to be classified, which must be free of granulation, is poured into a clean dry bottle. The bottle is then placed in compartment 2 or 4 of either comparator box.

(3) The comparator is held at a convenient distance from the eye and viewed by diffused light (e.g., by north sky, overcast sky, or diffused artificial light source provided by a tungsten lamp or a white or daylight fluorescent lamp). The color classification of the honey is then determined by comparison of the sample with the standards. Switching the sample from compartment 2 to 4, or vice versa, interchanging the clear blanks and the appropriate cloudy suspension, and in some cases shifting to the second comparator or using both comparators, may be necessary.

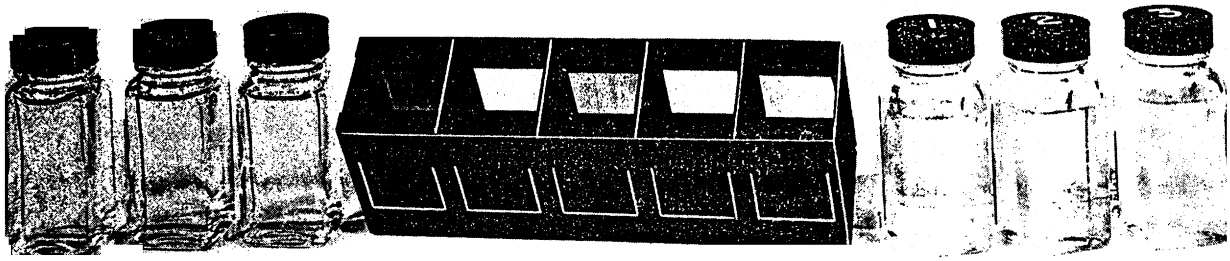

FIGURE 1

Color classifier for extracted honey (rear view), showing the mounted glass color standards, the clear blanks, and the cloudy solutions.

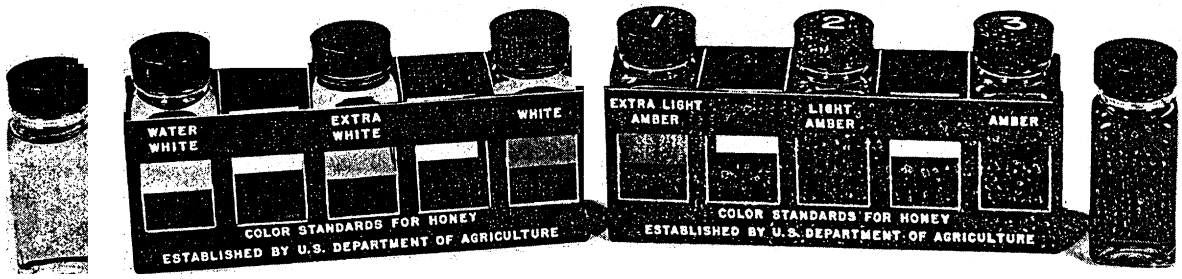

FIGURE 2

Color classifiers for extracted honey (front view), showing the blanks and cloudy suspensions in place behind the mounted color standards, and two samples of extracted honey to be classified.

If a sample is equal to the Water White standard in hue, or not as red (that is, yellower), the color is classified as Water White; if perceptibly redder than the Water White standard in hue, but not redder than the Extra White standard, the color is classified as Extra White; and so on. If redder in hue than the Amber standard, the color is classified as Dark Amber It is emphasized that hue (amber quality or redness) is the attribute of color to be considered in this classification.

Most honeys are appreciably cloudy because of the presence of air bubbles and fine suspended matter. In such cases the brightness of a sample is lowered and its color classification may be difficult to determine, particularly if its hue is near that of one of the color standards. In such cases color classification will be more easily determined if the clear blank is replaced by one of the cloudy suspensions. These suspensions are intended *only* as aids in the classification for color and *not* intended as standards for "clarity", which is one of the factors scored in ascertaining the U. S. Grade of honey[8]. They may in some cases, however, serve as aids in assessing clarity.

The honey color comparators, complete with permanent glass color standards, clear blanks, cloudy suspensions, and empty sample bottles, are now commercially available. Information on where they may be obtained, and additional details concerning them, may be obtained from the Fruit and Vegetable Branch Production and Marketing Administration, U. S. Department of Agriculture, Washington 25, D. C.; or from the Eastern Regional Research Laboratory, Philadelphia 18, Pennsylvania.

Table I. The U.S.D.A. color standards, with scale readings on the Pfund wedge comparator; spectral absorbance of caramel-glycerin solutions corresponding to standard scale readings.

U.S.D.A. Color Standards	Pfund Wedge Scale, mm.	Caramel-glycerin solutions, Absorbance* at 560 mμ	
		10 mm.	31.5 mm.
Water White	8	0.0300 **	0.0945
Extra White	17	.0600 **	.189
White	34	.119 **	.378
Extra Light Amber	50	.189	.595
Light Amber	85	.441	1.389 **
Amber	114	.979	3.008 **

Absorbance (optical density) = $\log_{10}$(100/per cent transmittance) measured versus an equal thickness of glycerin.

Calculated values.